

1 **AUTOMATIC VETERINARY MEDICAMENT DELIVERY SYSTEM**

2 **by**

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4 **BACKGROUND**

5 This invention relates to veterinary delivery devices for delivering medicaments, including
6 pharmaceuticals or vaccines, to a plurality of poultry or other animals. In particular, this invention
7 relates to a portable, electrically powered veterinary delivery system for reliably providing a precise
8 amount of pharmaceuticals, or vaccine, rapidly to a plurality of fowl, porcine, ovine or other animals.

9 Injection devices are known in the art. Numerous injection devices have been provided in
10 prior art that are adapted to include a manually operated plunger. A hand-held syringe, having a
11 barrel and manually operated plunger, has been used to administer vaccines, antibiotics and other
12 biological products. A problem with this device and method is that the accuracy of the dose is
13 dependent on the manual strength and attention of the operator. When injecting large numbers of
14 birds or other animals, the operator's hands become fatigued resulting in inaccurate doses being
15 delivered to the bird or other animal being injected. An additional problem has been accidental injury
16 to the operator as a result of either movement of the bird or other animal during the injection process
17 or lack of lighting present at the barn or other injection locale. Injection into a human of veterinary
18 products can cause permanent injury that may even result in amputation. Identifying which birds or
19 other animals have been injected within a flock or herd has also been a problem.

20 While these units may be suitable for the particular purpose which they address, they would
21 not be as suitable for the purposes of the present invention as hereinafter described.

22 **SUMMARY**

23 The present invention is directed to an automatic veterinary medicament delivery system that

satisfies these needs for delivery of precise amounts of medicament to an individual animal or fowl. The medicament includes any fluid products for immunizing purposes or for treatment. The system provides rapid and consistent one-handed administration of the medicament, without fatigue-affected changes in the amount of medicament delivered, to large numbers of fowl, porcine, ovine, or other animals. An automatic veterinary medicament delivery system having features of the present invention comprises an electronic control unit having means for quickly adjusting the dosage of medicament to be delivered by injection. The veterinary delivery system includes several hand-held injection devices from which to choose, depending on desired use, each having a push-button trigger, at least one needle, a headlight, signal lights, optional dye marking means, and an optional mixing chamber for mixing medicaments at the time of delivery of the medicament, the hand-held injection devices being easily connected and disconnected by means of quick connect fluid couplers for being in fluid communication with the system and a nine-pin amp electrical connector for being in electronic communication with the control unit. One embodiment hand-held unit provides a single needle for injecting especially the ear of cattle. Another embodiment hand-held unit provides a single needle plus marking means. A third hand-held unit provides two needles for injecting two unmixed medicines simultaneously. A fourth hand-held unit provides a single needle, but the hand-held unit is inverted with a pistol grip attached for use especially with thick-skinned animals, such as cattle or pigs. All of these hand-held units provide means to deter self-injection of the user. In some hand-held units, this safety device is in the form of an emergency stop button. In the fourth hand-held unit, a safety interlock is provided that prevents injection until a retractable resilient member is forced to a second, retracted position, to complete an electrical circuit permitting injection to take place. In all of these delivery systems, a source of fluid medicament, tubing interconnecting the injection device and the medicament, an electrically powered pump in fluid communication with both the injection device and the medicament, actuation means for activating a pump forcing the medicament through the tubing from medicament source to the injection device for dispensing, are provided. A quick connect fluid coupler permits coupling of each hand-held unit to the pump. A nine-pin amp electrical connector connects the electrical power portion of each hand-held unit to the control unit. Also, a convenient carrying system is provided. Optional means for marking injected animals are also included. Methods for administering two medicaments simultaneously are also provided.

1 Manually depressing a trigger on the hand-held injection device of this delivery system, in
2 conjunction with inserting a needle into the subject body, actuation of the pump causes fluid to
3 flow through the hollow needle accomplishing an injection. An emergency stop button is provided
4 if an error is made, e.x. the needle goes through the ear, or through the ear and into the user's hand.
5 This is an important deterrent to self-injection. An additional embodiment provides a safety interlock
6 member which must be depressed to the needle hub to close the electrical switch which in turn
7 actuates the pump causing fluid flow through the hollow needle only when the needle is fully injected
8 actuates an injection. This safety interlock is adjacent to the needle and positioned to extend to the
9 length of the needle. This safety interlock is then depressed to the point adjacent to the needle hub
10 as the needle is inserted. At this juncture, an internal extended rod from the safety interlock closes
11 the electrical circuit by means of a Hall-effect switch. This, in turn, actuates the pump to cause fluid
12 flow through the needle. This feature also deters accidental self-injection. Injection cannot take place
13 until the needle is fully inserted, thus enabling the operator to withdraw an accidental stab prior to
14 injection taking place. The goal of both of the systems is operator safety. Self-injection is a very
15 serious accident among vaccinating crews.

16 The delivery system includes a means of marking, by automatically pressing an applicator pad
17 containing a pre-measured amount of dye pumped into it, in order to prominently and automatically
18 mark each treated animal adjacent to the injection site.

19 The delivery system is powered by a compact, rechargeable 12-volt battery or 110 volt AC/12
20 volt DC converter for sustained operation reducing fatigue and the likelihood of repetitive stress
21 injury to the operator.

22 The delivery system includes a self-priming peristaltic pump for delivery of a consistent
23 amount of medicament. The pump also reverses to retrieve unused medicament upon completion of
24 each injection chore. The use of a peristaltic pump permits the system to be valve-free.

25 The delivery system has an optional head lamp at the injection site for greater safety and
26 accuracy of injection. The delivery system includes a green LCD on the handle to indicate that an
27 injection is in progress. A red LCD on the handle indicates the medicament fluid is low.

28 The delivery system also includes an automatic counter to record and total the numbers of
29 injections.

1 The delivery system also includes an optional mixing tube to combine medicaments.

2 The delivery system also includes a cleaning process to clean the tubing of the delivery system
3 following each job. To accomplish cleaning, the pump switch on the face of the control unit is set
4 to "forward" in order to circulate cleaning/sanitizing solutions for effective "clean in place".

5 The system is enclosed in a back-pack or box, which protects it from dirt and dust and also
6 provides a convenient place to store and transport the component parts.

7 It is the general object of the present invention to provide a novel and improved multiple dose
8 veterinary delivery system that provides a precise dosage to a plurality of animals without requiring
9 frequent refilling of the system between administrations of medicament to a plurality of animals.

10 A further object is to provide a veterinary delivery system which can be manipulated with one
11 hand freeing up the second hand of the user to hold onto the subject animal for injection.

12 It is a further object to provide a veterinary medicament delivery system which ensures
13 administration of precise amount of a medicament to the animal.

14 It is a further object of the invention to provide a veterinary delivery system that uses a self-
15 priming pump.

16 It is a further object of the invention to provide a veterinary delivery system that eliminates
17 waste of medicament and that provides an accurate count of doses delivered.

18 Another object is to increase the safety features of such an injection system by reducing the
19 hazard of self-inoculation of the operator. A further object is to provide an easily transportable
20 injection system.

21 Other objects and advantages will become apparent from the following detailed description
22 and accompanying drawings.

23 BRIEF DESCRIPTION OF THE DRAWINGS

24 Understanding of the invention will be enhanced by referring to the accompanying drawings,
25 in which like numbers refer to like parts in the several views and in which:

26 **Fig. 1** is a plan view of the medicament delivery system of the current invention;

27 **Fig. 2** is a perspective view of the first embodiment hand-held unit of the medicament

delivery system of **Fig. 1**;

Fig. 3 is a side view of a hand-held unit of the medicament delivery system of **Fig. 2**;

Fig. 4 is a side perspective view of a second embodiment hand-held unit of the medicament delivery system of **Fig. 1**;

Fig. 5 is an end view of a third embodiment pistol grip hand-held unit;

Fig. 6 is a perspective view the control unit of the medicament delivery system of **Fig. 1**;

Fig. 7 is a perspective view of the interior of the control unit of **Fig. 6**;

Fig. 8 is a plan view of the second embodiment hand-held unit where two medicaments are pumped through two pumps simultaneously at the same rate;

Fig. 9 is a plan view of the second embodiment hand-held unit where two medicaments are pumped through two separate control units at differing rates;

Fig. 10 is a plan view of the medicament mixing tube;

Fig. 11 is a side view of the third embodiment pistol grip hand-held unit;

Fig. 12 is a plan view of the fourth embodiment hand-held unit where one medicament is injected and a dye pad applicator is present; and

Fig. 13 is a side view of the fifth embodiment, pivoting hand-held unit, with certain portions shown in cross-section.

DETAILED DESCRIPTION OF THE CURRENTLY PREFERRED EMBODIMENTS

Understanding of the invention will be further enhanced by referring to the following illustrative but non-limiting example.

The term "medicaments" is intended to include serum, vaccine, antibiotics, and any other fluid products that may be used for immunizing or for treating poultry, bovine, ovine, porcine or other animals.

OVERVIEW

Turning now to the drawings, in which like reference characters refer to corresponding elements throughout the several views, **Fig. 1** illustrates an electrically powered automatic veterinary medicament delivery system, shown generally at **20**. System **20** is housed in a container such as a

back pack and includes a hand-held unit 40 in fluid communication, by means of conduit tubing tubing 78, with a medicament container 70. A first embodiment hand-held unit 40, single needle 56, no dye means, is especially for use in injection of a medicament into the ear of a bovine. All of the hand-held units 40 have a generally cylindrical shape with a flattened surface 41 on which, in embodiments one through three, are mounted both a trigger 42 and an emergency stop 44 button. The fourth embodiment also has a trigger but no emergency stop. Also shown are a green LCD 48, which lights to indicate an injection is in progress, and a red LCD 50 which lights to indicate that the medicament level is low. The "function" key pad 108 is touched on the control unit 110 to set the anticipated number of total count so that the low medicament bottle LCD lights up at the appropriate time, ex. when 90% of the doses have been given. Head lamp 46 is used to illuminate the area of injection, as well as an optional dye pad 172 along with the needle mount 58, in actual use, a Luer lock, all mounted on a proximal surface 22 of the hand-held unit 40". Entering this distal end 24 of hand-held unit 40" is tubing 82 containing medicament 84, dye 86 and electrical power cords 88. All of the various hand-held unit embodiments 40, 40', 40", & 40"' look and work similarly. A pump 100, which sits atop a control unit 110, sucks up the medicament from within medicament container 70 through tubing 80 and forces the fluid medicament from pump 100 exiting through tubing 82 and continuing through conduit tubing 78 for delivery by the hand-held unit 40 through a hollow needle 56. The control unit 110 utilizes an electronic dosage control 130, shown in detail in Fig.7, to deliver a predetermined precise amount of medicament upon injection. Additionally, the electronic dosage control 130 provides means of changing the dosage of these predetermined precise amounts of medicament. Control unit 110 also provides optional marking means. Marking dye, in an optional embodiment shown at Figs. 2,3,& 5, is delivered through dye means, such as by an applicator pad 172, simultaneously with injection of the medicament, marking the individual poultry, porcine, ovine or other animal injected. Control unit 110 function key pad 108 has an on/off control of dye means. Control unit 110 also provides for counting the number of injections made.

In all of the disclosed embodiments, fluid from more than one medicament container 70 can be injected simultaneously through their respective tubing 80, the medicaments forced by the pump 100, through an optional mixing tube 190, shown in detail in Fig. 10, intermixing the two

1 medicaments prior to their being injected through the selected hand-held unit 40, 40', 40'', 40'''.

2 Additionally, in all of the embodiments, fluid from more than one medicament container 70, 70' can

3 be injected simultaneously. Where different dosages are needed, two control units 110, 110' with

4 the associated pumps 100, 100' can be connected up to a single hand-held unit 40, 40', 40'' 40''' for

5 simultaneous injection, either after mixing the medicaments and injected through hand-held unit 40

6 40'' and 40''' , or when the medicaments cannot be mixed for whatever reason, by injecting

7 simultaneously through two needles through hand-held unit 40' as shown in Fig. 4. Once the

8 requirements are determined, which medicaments are to be injected, can they be mixed, if not, are

9 they administered at the same dosage, the appropriate hand-held unit 40, 40', or 40'' is selected and

10 electronically connected to control unit 110 by the Amp connector 94, attached to the end of conduit

11 tubing 78 and in fluid communication by means of a quick connect fluid connector 196 at the end of

12 each tubing 82, 76,. If the medicaments may be mixed, the mixing tube 190 must be attached to the

13 tubing 82 by quick connect fluid couplers 196. Quick connect fluid couplers 196 are also mounted

14 on pump 100 to attach tubing 80 to medicament container 70 . If more than one pump is needed but

15 the medicament to be administered can be given at the same dosage, then a two pump system 100,

16 100', such as shown in Fig. 8, is used. Either hand-held unit 40 or 40' or 40''' may be used. When

17 the medicament to be administered is not of the same dosage, and cannot be mixed, then two control

18 units 110, 110' must be used, such as shown in Fig. 9, then hand-held unit 40'' is selected and

19 connected to both control units 110, 110' by means of conduit tubings 78, 78'. A nine-pin amp

20 connector 94 connects the electronic control unit 110 to any of the hand-held units 40. A four-pin

21 amp connector 122 connects the electronic control unit 110 to the dye pump. Another four-pin amp

22 connector 124 connects the control unit 110 to the battery 126. These different types of amp

23 connectors protect against accidental connection of the wrong device to the outlet at the control unit

24 110.

25 The control unit 110 sets the dosage, the injection count, the anticipated number of total

26 count so that the low medicament bottle LCD lights up at the appropriate time, and optional

27 marking dye by means of touching the display LCD for each function, by pushing the "Function"

28 keypad 108 and using the up and down arrows 106 to select the appropriate choice, dose, injection

29 count, low bottle warning and marking dye.

1 As shown in **Fig. 1**, the electrically powered automatic veterinary medicament delivery system
2 is set for injecting ears of cattle. While the hereinafter described safety interlock could be added to
3 this hand-held unit **40**, it is not felt to be necessary when injecting ears of cattle. The ears are
4 injected, by the way, to prevent damage to an edible portion of the cattle.

5 The power source for running any embodiment of this system is a re-chargable battery
6 although plugging into the circuitry of the barn or other housing could be used.

7 **Fig. 2** is a side perspective view of second embodiment hand-held unit **40'** of the medicament
8 delivery system **20**, having a single needle **56** and dye pad applicator **172**. In this view, hand-held unit
9 **40'** has a generally cylindrical shape with a flattened dorsal surface **41** on which are mounted both
10 a trigger **42** and an emergency stop **44** button. Also shown are a green LCD **48**, which lights to
11 indicate an injection is in progress, and a red LCD **50** which lights to indicate that the medicament
12 level is low. The "function" key pad is touched on the control unit **110** to set the anticipated
13 number of total count so that the low medicament bottle LCD lights up at the appropriate time, ex.
14 when 90% of the doses have been given. Head lamp **46** is used to illuminate the area of injection, as
15 well as an optional dye pad **172** along with the needle mount **58**, in actual use, a Luer lock, all
16 mounted on a proximal surface **22** of the hand-held unit **40'**. Entering this distal end **24** of hand-held
17 unit **40'** is tubing **82** containing medicament **84**, dye **86** and electrical power cords **88**. This hand-held
18 unit **40'** is especially for use in injection of a medicament into a bovine at a point other than the ear.
19 Marking means conspicuously mark the animal as it is injected. Quick connect fluid couplers **196** are
20 mounted on the terminal ends of both medicament tubing **82** and dye tubing **86** to permit quick,
21 convenient connection of this particular hand-held unit **40''** to control unit **110**.

22 **Fig. 3** is a side view of the hand-held unit **40'** of the medicament delivery system of **Fig. 2**
23 showing an additional light **52** indicating that an injection is in progress.

24 **Fig. 4** is a side perspective view of a third embodiment hand-held unit **40''** of the medicament
25 delivery system of **Fig. 1**. This embodiment has the same general shape as the first embodiment,
26 namely hand-held unit **40''** having a generally cylindrical shaped body with a flattened dorsal surface
27 **41** on which are mounted both a trigger **42** and an emergency stop **44** button. This embodiment
28 adds a second needle **56'** and needle mount **58'** Luer lock to the proximal surface of the hand-held
29 unit **40''**. Although the optional dye applicator pad is not shown, it will be understood that this dye

1 applicator pad is an option on all of the hand-held units. Also not shown in this view but understood
2 to be mounted on the hand-held unit 40'' is an additional light indicating that an injection is in
3 progress similarly to light 52 in Fig. 3. Two needles 56, 56' are needed with this embodiment
4 because two medicaments that may not be mixed are being injected, as indicated by the two
5 medicament tubings 82, 82'. Quick connect fluid couplers 196 are mounted on the terminal ends
6 of both medicament tubings 82, 82' and dye tubing 86, 86' to permit quick, convenient fluid
7 connection of this hand-held unit 40'' to control unit 110. If the dosage is the same for both
8 medicaments, a second pump 100' can be mounted atop the first pump 100, as shown in Fig. 8,
9 connected to a hand-held unit 40''. The two pumps, 100, 100' piggy backed atop the other, are
10 interconnected by an drive shaft 134 whereby the pumps turn at the same rate of speed delivering
11 identical amounts of medicament. If, however, different dosages of the two medicaments is needed,
12 due to differences in viscosity or potency, or the like, two control units, 110, 110' would be needed,
13 as shown in Fig. 9. The tubing from both units would be combined so only one hand-held unit 40''
14 is needed. Although only one processing of the subject animal occurs, two injections of different
15 un-mixed medicaments are given simultaneously to the same subject animal.

16 **Fig. 5** is an end view of a fourth embodiment hand-held unit 40''' which has a pistol grip 30.
17 In this embodiment, the generally cylindrically shaped hand-held unit 40''' is basically turned upside
18 down so that the flattened surface is on the ventral side. The trigger 42 is mounted on the front
19 surface of the pistol grip 30 for convenience of the user. This embodiment has the same elements
20 on the proximal surface 22, namely a needle mount 58, a hollow needle 56, an optional dye means
21 170, with associated dye tubing 86, and headlight 46. Added to this embodiment is safety interlock
22 150 which consists of a solid member 152, which when forced by contact with the subject animal
23 skin, from a first, extended position, to a second retracted position in alignment with the proximal
24 surface 22, releases the needle mount to allow injection to occur. The safety interlock 150 is
25 designed to prevent accidental injection of the human user of the system. Accidental injection of
26 certain veterinary products can cause severe injury of the area accidentally injected. Mounted on
27 hand-held injection device 40''' is solid member 152, a solid member preferably of plastic, which in
28 its first position, extends at least as far as the tip of needle 56. Solid member 152 is urged to a second
29 position, pushed to the tip of the needle hub 57, as indicated by arrow in Fig.11, when the needle 56

1 and therefore the solid member 152 comes into contact with the body of the poultry or other animal.

2 When solid member 152 is biased to the second position, it completes the electrical circuit and
3 actuates the pump 100 which permits an injection to take place. This built-in safety device deters
4 accidental, and severely injurious, self-injection. Needle 56 is replaceable. When needle guard solid
5 member 152 reaches a second position, it actuates a Hall effect switch, internal of the hand-held
6 injection device 40, 40', 40" which controls administration. This Hall effect switch is wired in
7 conjunction with the trigger 42 on the hand-held injection device 40", making it necessary for the
8 trigger 42 to be depressed in order for the switch at the solid member 152 to work. This feature adds
9 materially to the safety and reduced fatigue of the operator, as well as the speed of operation since
10 the operator can depress the trigger 42 constantly allowing injection to occur automatically and as
11 quickly as solid member 152 is depressed.

12 Trigger 42 is in electrical communication with pump 100. In the fourth embodiment of
13 hand-held injection device 40"" trigger 42 must be depressed, and the needle 56 must be fully
14 inserted, to complete the electrical circuit in the Hall effect switch which actuates the pump 100 and
15 results in an injection. This hand-held injection device 40"" has a safety interlock 152. The other
16 embodiments, 40, 40' & 40" have an emergency stop button 44, although a safety interlock 152 could
17 be used on all embodiments. At this time, a safety interlock is not deemed necessary on hand-held
18 injection device 40 because it is primarily used on the ears of cattle where the needle is parallel to the
19 ear. A safety interlock would not have any animal body part to urge the interlock to it's second,
20 retracted, position. Also at this time, a safety interlock is not deemed necessary on hand-held
21 injection device 40' because this embodiment is primarily used on soft-tissued animals such as poultry
22 where again the safety interlock would not have a substantial body part to urge the interlock to it's
23 second, retracted, position. A dye source is indicated at 60 with its associated tubing 86 which
24 interconnects, again by a quick connect fluid coupler, to conduit tubing 78 that is in fluid
25 communication with hand-held injection device 40"".

26 Fig. 6 is an external illustration of the control unit 110 of the medicament delivery system
27 20 of this invention with pump 100 mounted on top. In all embodiments, control unit provides
28 electrical power to hand held units 40 as well as electronic information is set in electronic control to
29 control dosage, dye on/off, and amount, injection count and low medicament level as well as the

automatic reverse feature following each injection. A nine-pin amp electrical connector **94** connects the electronic control unit **110** to any of the hand-held injection devices **40**. A four-pin amp electrical connector **122** connects the electronic control unit **110** to the dye pump. Another four-pin amp connector **124** connects the control unit **110** to the battery **126**. These different amp electrical connectors protect against accidental connection of the wrong device to the outlet at the control unit **110**. Display **112** is an LCD display which lights up to illustrate the different modes of the control unit **110**, namely, the amount of the selected dosage, the amount of dye used per subject animal, and the count of injections made. The dosage, which is controlled by setting the number of pulses that are emitted by the electronic photo optic sensor **138** to accurately inject the desired dose, depends on the viscosity and temperature of the medicament and must be calculated at each injection session. For example, very low viscosity liquid, such as water, requires 44 pulses per 1.0 milliliter (ml) while on the other hand, dosages of high-viscosity vaccines could require as many as 110 pulses per 1.0 milliliter (ml). The number of pulses in an injection is manually controlled by the up and down arrows **106** on the face of control unit **110**, can be set at each injection session. Whether or not to use dye and the amount of dye used can also be selected by control unit **110**. The amount of dye to be used can be set in 0.1 second increments. The injection count can be re-set to zero after each injection session by means of the up and down arrows **106**. Switches on the face of control unit **110** include an on-off power switch **114**, pump switch **116** that controls forward or reverse pump, and light switch **120** which controls power to the head lamp **46**.

Being able to switch the pump to reverse enables reclaiming of the sterile serum, or other medicament, that is in the tubing and in the hand-held injection device **40**, and pump **100** itself. Reversing the pump **100** at the end of each job, by switching upwardly switch **116**, effectively retrieves medicament in the system to the container **70** or to be discarded. This procedure can then be followed by switching the pump switch **116** to "forward" to 'clean-in-place' the system **20** by pumping hot detergent water followed by a rinse, or any cleaning procedure outlined by the user. In actual use conditions, an on/off switch such as model # SLP 130A4-16, made by Honeywell, Minneapolis, MN power switch has been used although other comparable power switches could be substituted without changing the invention.

Tubing **80** provides medicament to pump **100** while tubing **82** leads from the pump **100** to the

particular hand-held injection device 40 selected.

Fig. 7 is a perspective view of the interior of the control unit of Fig. 6. Electronic dosage control 130 uses a photo-optic unit to control the volume of medicament fluid pumped by pump 100. Pump 100 drives shaft 134 which turns an encoder disc 132 that has slots that are placed at a calibrated distance from one another around the perimeter of circular encoder disc 132. As the encoder disc 132 rotates in response to rotation of drive shaft 134, the slots pass between an emitter and a receiver of a photo-optic sensor 138. The encoder disc 132 passes through the sensor 138.

The sensor 138 "counts" the number of slots that pass between an emitter and receiver. The combination of the distance between the slots and the number of slots allowed to pass through the sensor 138 determines the amount of serum that is dispersed. This sensor 138 is wired into a circuit board 140 which includes a micro chip 142 which allows selection and control of the distance the fluid travels in pump 100. This method is preferred because of the ease in changing doses and in view of the changing viscosities of the medicaments used. To change the dose, the user manipulates the function mode by pressing the "Function" key pad 108, of control unit 110. The current number of pulses will flash on the display 112. The pulse count can then be changed by pressing the "UP" or "DOWN" key pad 106 until the correct number of pulses are shown. The press the "Function" keypad 108 to set the correct dose. The LCD display 112 will then stop flashing.

Counter also displayed on LCD display 112, records a dispensed dosage every time any of the hand held units 40 is activated. If desired, the counter keeps a running total of the number of injections given while the veterinary medicament delivery system 20 is turned on. The counter is reset manually by using the down arrow 106. A micro switch liquid crystal display (LCD) unit, made by Curtis Instruments, Inc., 204 Kisco Ave., Mt. Kisco, NY 10549, has been used and works well although other LCD's could be used.

The dosage is set depending on the number of light pulses sensed by the photo optic sensor 138. The user determines how many pulses are equal to 1.0 cc of the injectible medicament and calculates the desired dosage, then determines the number of pulses required for the correct dosage. This setting is reached by, first, pressing the "Function:" key pad 108, at which time the current setting will flash in the LCD 112. Then, by use of the "UP" or DOWN" keypads 106 move the number of pulses to the desired dosage setting at which time the "Function" key pad 108 should be

1 pressed to set the correct dose. The LCD 112 will then stop flashing. The appropriate dose is
2 selected by using the LCD display 112 on control unit 110.

3 **Fig. 8** illustrates the third embodiment hand-held injection device 40" used to simultaneously
4 inject two medicaments of similar viscosities. Because these two medicaments may not be mixed,
5 for whatever reason, they are run through separate pumps, 100 and 100' which are interconnected
6 by an extension of drive shaft 134, shown in detail in Fig. 7. Tubing 82 & 82' carries the pumped
7 medicaments separately to hand-held injection device 40" for simultaneous injection. **Fig. 9**
8 illustrates the third embodiment hand-held injection device 40" in the case of desiring to
9 simultaneously inject two medicaments of different viscosities. Again, these two medicaments are
10 not to be mixed, for whatever reason, and are run through two separate control units, 110 & 110'
11 before being run through tubing 78 & 78' into hand-held injection device 40".

12 **Fig. 10** is a side view of a medicament mixing tube 190 with quick connect fluid connectors
13 196 at either end. Y-shaped coupling 198 brings together the two medicaments to mixing tube 190.
14 This tubing is inserted in the tubing somewhere between the pump 100 and any of the hand-held
15 injection devices 40, 40', or 40"". Injectible medicaments from two different sources may be mixed
16 together by use of this mixing tube 190 prior to injection. This is used where the separate injectibles
17 are compatible. In the case where they are not able to be mixed for some reason, the two injection
18 hand-held injection device 40" is used. In use, the mixing tube 190, having a cylindrical barrel
19 chamber 192 with a centrally positioned mixing member, double helix fins 194 shaped as two worm
20 gears rotating in opposite directions, is provided enabling mixing together of two fluids for delivery
21 to any of the hand-held injection devices 40, 40', 40" or 40"".

22 Optional marking means is provided in the form of an applicator pad 172 that marks dye
23 onto the subject animal or fowl at the time of injection to conspicuously mark an individual within
24 a group that has been injected.

25 Hand-held injection device

26 First hand-held injection device 40, shown in detail in Fig. 1 has a one-piece generally
27 cylindrical housing with a trigger 42 and an emergency stop button 44 mounted on the flattened
28 dorsal surface 41. A red LCD 50 indicates low medicament bottle level while green LCD 48

1 indicates an injection is in progress. Both are also mounted on the dorsal surface 41. An
2 additional injection in progress LCD 52 is mounted on the distal surface 24 of the hand-held
3 injection device 40, as shown in Fig. 3. Head lamp 46 and dye applicator pad 172 are mounted on
4 the proximal surface of hand-held injection device 40. The needle mount 58, in actual use a Luer
5 lock, receives hollow needle 56. Emergency stop button 44 provides means for preventing
6 accidental injection. The medicament in tubing 84 travels from the pump100 and is joined by dye
7 in tubing 86. Both are wound together with power cord 88 into a larger tubing 78 that is
8 received by the distal surface 24 of hand-held injection device 40. Dye applicator pad 172, into
9 which dye is pumped, extends from the hand-held injection device 40 and onto the animal to
10 automatically mark the animal at each injection. Hand-held injection device 40 is especially useful
11 in injection of thin-skinned areas, for example, the ears of cattle.

12 Hand-held unit 40', shown in Figs. 2 & 3, is similar in most respects to the first
13 embodiment but adds a dye applicator pad 172. Hand-held injection device 40'', shown at Fig. 4,
14 adds an additional hollow needle 56' and needle mount 58'. In this embodiment as illustrated in
15 Fig. 4, has an addition second medicament tubing 82' and power cord 88'. Emergency stop
16 button 44 provides means by which to deter accidental self-injection. The medicament in tubing
17 82 travels from the pump100 and is joined by pumped medicament in tubing 82'. Both are
18 wound together with power cord 88 into a larger conduit tubing 78 that is received by the distal
19 surface 24 of hand-held injection device 40''. Hand-held injection device 40'' is especially useful
20 in injection of poultry.

21 Hand-held unit 40''', Fig. 5, is similar in most respects to the first, second and third
22 embodiments but the housing of hand-held injection device 40''' is inverted and a pistol grip 30
23 with the trigger 42 mounted thereon, is added. A safety interlock 150, with solid member 152, is
24 mounted on the proximal surface 22, is used as means for preventing accidental self-injection.
25 The medicament in tubing 82 travels from the pump100 and is joined by dye in tubing 86. Both
26 are wound together with power cord 88 into a larger conduit tubing 78 that is received by the
27 distal surface 24 of hand-held injection device 40'''. Dye applicator pad 172, into which dye is
28 pumped, extends from the hand-held injection device 40''' and onto the animal to automatically
29 mark each animal at each injection. Hand-held injection device 40''' is especially useful in

1 injection of thick skinned animals such as pigs, sheep and cattle in places other than the ear.

2 Hand-held unit 40''', Fig. 13, is similar in most respects to the first, second, third and
3 fourth embodiments but the housing of hand-held injection device 40''' is a two piece housing
4 with a head portion 32 and a handle portion 34 connected by pivot 36 with the trigger 42
5 mounted on the handle portion 34. A safety interlock, with solid member 152, is mounted
6 adjacent the hollow needle 56 and is used as means for deterring accidental self-injection. The
7 safety interlock with solid member 152 has a spring 38 to urge the safety interlock solid member
8 152 into a first position, extending at least as far as the needle 56. Safety interlock with solid
9 member 152 is urged to a second position, pushed to the tip of needle hub 58 as indicated by
10 arrows in Fig. 13, when the needle 56 comes into contact with the body of the poultry or other
11 animal. When safety interlock solid member 152 is biased to the second position, it completes an
12 electrical circuit, a Hall effect switch 31, and actuates the pump 100. The medicament in tubing
13 82 travels from the pump 100 and is joined by dye in tubing 86. Both are wound together with
14 power cord 88 into a larger conduit tubing 78 that is received by the distal surface 24 of hand-
15 held injection device 40'''. Dye applicator pad 172, into which dye is pumped, extends from the
16 hand-held injection device 40''' and onto the animal to automatically mark each animal at each
17 injection. The pivot 36 permits re-positioning of the handle portion 34 relative to the head
18 portion 32 to enable the user to more comfortably fit the injection device 40''' to his or her hand
19 for prolonged use and to facilitate different types of injections as when changing between injecting
20 swine and poultry.

21 All hand-held units 40, 40', 40'', 40''' 40''' are equipped with a hollow needle 56 which
22 is in fluid communication, through injection set tubing 82, with the liquid medicament container
23 70. When the needle 56 is inserted, the medicament fluid is injected.

24 In all of the hand-held injection devices 40, 40', 40'', 40''' & 40''', electrical wiring is
25 connected to port on the control unit 110 by a durable, water resistant electrical amp connectors
26 94, 122, 124, such an electrical connector is made by Time Electronic Supply Co., 7803 Green Bay
27 Rd. Suite 302, Bloomington, MN 55439. A nine-pin amp connector 94 connects the electronic
28 control unit 110 to the hand-held injection device 40. A four-pin amp connector 122 connects the
29 electronic control unit 110 to the dye pump. Another four-pin amp connector 124 connects the

control unit 110 to the battery 126. These different amp connectors protect against accidental connection of the wrong device to the outlet at the control unit 110. A quick connect fluid coupler 196, such as that made by Coulder Products Co., 1001 Westgate Dr. St. Paul, MN 55114, connects the injection set tubing 80, 82 to pump 100 and also to mixing tube 190. The quick connect fluid couplers 196 enable the user to select the hand-held injection device 40, 40', 40", 40''' or 40'''' needed and also to disconnect the tubing when replacement is needed. The quick connect fluid couplers 196 also permits the hand-held injection devices 40, 40', 40", 40''' or 40'''' to be disconnected for ease of transportation and storage. Additionally, the quick connect fluid couplers 196 are water proof to a submersible depth of three feet. This connector seals tightly and will prevent dirt and grime from entering the electric contacts that they are protecting.

All hand-held injection devices 40, 40', 40", 40''' & 40'''' are also equipped with a light emitting diode as an illuminating head lamp 46, mounted adjacent to the needle 56. A diode such as model HLMP-1503, made by Gilway manufacturer has been used and works well although other light emitting sources could also be used. Head lamp 46, is in electrical communication with battery 126, Fig.1, provides illumination in low light areas, such as barns, and further attracts attention to the needle 56 to prevent accidental self-injection by user. Poultry are vaccinated in low light in order to keep the birds calm.

Several indicator lights are located on all hand-held injection devices 40, 40', 40", 40''' & 40'''' . Low serum bottle level is indicated by red LCD signal light 50 set to the count and will light when the bottle is down to approximately 10% of capacity, e.g. in a 250ml bottle, signal light 50 lights when the bottle is down to about 25. A green LCD 48 mounted on hand-held injection devices 40, 40', 40", 40''' , 40'''' light to indicate an injection is in progress. These LCDs are in electrical communication with battery 126 by means of wiring 88. The reverse mode is used to retrieve unused medicament at the end of each job thereby reducing waste of medicament. The reverse mode must be set, by means of the "function" button 108 and the down arrow 106 prior to the dosage being set. In actual use conditions, a simple LCD, such as made by model MV-1000 made by Gilway has been used and works well however other LCDs having similar features could be used.

1 In all of the hand-held injection devices 40, 40', 40", 40''' & 40''', optional dye means
2 is simultaneously dabbed from dye applicator pad 172 to mark the animal or fowl injected, the
3 applicator pad 172 interconnected by dye fluid tubing 86 to a dye container, and is applied in
4 response to again manually pushing main trigger 42 inwardly. There is no separate trigger for
5 controlling the dye function.

6 PUMP

7 In use, a peristaltic-type pump 100 creates a vacuum within tubing that sucks up the fluid
8 from the medicament container 70 by repetitively compressing and expanding a section of
9 tubing. In actual use conditions, a relatively large bore high density plastic tubing has been used
10 with great success. The size of the tubing bears a direct relationship to the length of time it takes
11 to complete an injection, namely, the larger the tubing, the quicker the injection time. This
12 repetitively compressing and expanding a section of tubing creates a vacuum within the tubing and
13 provides the force to move the fluid from the medicament container through the system to the
14 hand held unit 40, 40', 40", 40''' or 40''' without introducing contamination into the system.
15 In actual use conditions, a peristaltic-type pump such as that made by Barnant Co., 28W 092
16 Commercial Ave. Barrington, IL 60610, has been used although other peristaltic-type pumps
17 could be used. The peristaltic-type pump 100 may additionally be set so that the serum, or other
18 fluid medicament, may be sucked up automatically from the hand-held injection device 40, 40',
19 40", 40''' or 40''' by manually reversing the pump 100, to prevent waste. The pump 100 is
20 self-priming. The user simply continues to push trigger 42 until serum or other fluid medicament
21 reaches hand-held injection device 40, 40', 40", 40''' 40'''. A second peristaltic-type pump
22 100' may be provided and mounted in a piggy-back manner to force a second fluid medicament
23 through the system at the same rate for delivery through the hand-held injection device 40".
24 Pump 100 is driven by motor 104, Fig. 7, in actual use a 12 volt motor, model # 33GN2732-276
25 GHS, made by Power Electric Products, 2285 Daniels St. Long Lake, MN 515 has been used
26 although other similar 12 volt motors could be used.

27 Because peristaltic pump 100 works on the premise of displacement, pump 100 accurately and
28 consistently delivers the same dosage. The dose delivered can be formulated by multiplying the

1 inner cross-sectional area of the tubing inside the pump 100 by the distance the tubing is
2 compressed during one cycle of the peristaltic pump. Each time trigger 42 is manually depressed
3 and safety interlock 152 is pushed to its second position in response to needle 56 being fully
4 inserted, the exact dosage is dispensed by pump 100. This increases accuracy of delivery of the
5 dosage and eliminates user error caused by fatigue.

6 Battery 126 powers motor 104. In actual use conditions, a 12 volt, sealed, lead acid,
7 rechargeable battery, such as model # DG 12-4.2 Guardian made by Douglas Co. has been used
8 although other similar batteries could also be used. One battery charge should be able to power
9 the device 20 through one full day of injections.

10 CASE

11 Any of the embodiments of veterinary medicament delivery system 20 can be housed in a
12 resilient, light weight material backpack, or other housing, so long as the housing protects the
13 various elements of the veterinary medicament delivery system 20 from dirt and dust. Having the
14 system stored in a backpack enhances portability and storage of the system 20.

15 Draw-off needle is held in place inside medicament container 70. Tubing 80 is attached at
16 a first end to intake tubing and at a second end to a lead-in tubing for a peristaltic-type pump
17 100.

18 MIXING TUBE

19 An optional mixing tube 190, Fig. 10, is provided to mix together two medicaments prior
20 to the medicaments being injected. Mixing tube 190 consists of a chamber 192 with double helix-
21 shaped fins 194 that, when two fluids are introduced through a Y-shaped coupling 198, the two
22 fluids are intermixed as they are pushed down mixing tube before exiting through quick connect
23 fluid coupler 196. As fluids flow through mixing tube 190, the fluids, not shown, pass over a
24 series of stationary, helical-shaped fins 194 which causes the fluids to fold over on themselves. In
25 this manner the fluids are completely mixed in a short distance, e.g. three inches.

26 DYE APPLICATOR

27 Dye reservoir 60 has an intake tubing affixed to reservoir 60 that draws up dye in response
28

1 to a separate dye pump. Dye is drawn into dye tubing 86 in fluid communication with any of the
2 hand-held injection devices 40, 40', 40", 40''' or 40''''', but especially with 40''' & 40'''''. Dye
3 intake tubing 86 draws up dye in response to activation of a dye pump in response to activation of
4 the dye pump by the injection circuit. This pump delivers dye to the applicator pad in increments
5 of 0.1 second for each injection. By setting the dye pump at zero, the dye can be discontinued if
6 desired.

7 Dye applicator pad 172 is mounted on the proximal surface 22 of hand-held injection
8 device 40, 40', 40", 40''', or 40'''' adjacent needle 56 and head lamp 46. Dye applicator pad
9 172 is in fluid communication with dye reservoir 60. It has been found that dye is dabbed onto
10 the animal's coat or skin simultaneously with the injection works well. The dye applicator pad
11 dabs the dye in 0.1 second increments, depending on the control unit 110 setting. The dye marks
12 the animal injected so that it is easy to distinguish between animals that have been vaccinated or
13 injected and those that have not. This feature is a switched function and can be turned on or off
14 according to the needs of the job, as set by the function key of control unit 110.

15 DOSAGE CONTROL

16 In all embodiments, the selected dosage is administered cleanly and completely, without
17 dripping because the pump 100 is set to automatically reverse at the end of each injection. The
18 amount of this reverse is set into control unit 110 before the dosage is set. This automatic reverse
19 prevents serum, or other fluid medicament, from flowing out of the end of the hand-held injection
20 device 40, 40', 40", 40''', or 40'''' due to latent pressure. A quick reverse after each injection
21 prevents drip. It is important, also, to retrieve unused medicament at the end of each injection
22 session. The pump reverse switch is used to retrieve unused medicament at the end of the
23 injection session. The need for reversing fluid flow does not allow for use of a delivery valve
24 because such a valve would prevent any reverse action.

25 It is an important feature of this system that it does not include a delivery valve. The
26 absence of a delivery valve necessitates a positive, abrupt stop upon the completion of each
27 injection followed by a quick reverse by which drip can be prevented. The injection process,
28 therefore, involves an automatic abrupt stop upon delivery of each dose, immediately followed by
29 a short pre-set reverse sufficient to prevent any drip. This reverse can differ according to the

viscosity of the medicament and should be set prior to the start of each injection session, usually 8-10 pulses. By setting this reverse action prior to setting the correct dosage, the precise delivery of each injection is not impaired. The automatic reverse is set using the "Function" keypad **108** and the down arrow **106** on the front of control unit **110**.

Electronic dosage control **130** uses a photo-optic sensor **138**, shown in detail in **Fig. 7**, to control the volume of medicament fluid pumped by pump **100**. Pump **100** drives shaft **134** that turns an encoder disc **132** that has slots that are placed at a calibrated distance from one another around the perimeter of circular encoder disc **132**. As the encoder disc **132** rotates in response to rotation of drive shaft **134**, the slots pass between an emitter and a receiver of the photo-optic sensor **138**. As the encoder disc **132** passes through the sensor **138**, the sensor **138** "counts" the number of slots that pass between an emitter and a receiver inside a dark housing within the control unit **110** adjacent the pump **100**. The combination of the distance between the slots and the number of slots allowed to pass through the sensor **138** determines the amount of medicament that is dispersed. This amount is dependent on the viscosity of the medicament and the temperature of the medicament. Setting the required number of pulses by the photo-optic sensor to accurately administer the necessary precise dose is usually accomplished by taking measure of a set number of pulses, maybe 200, then calculating the required pulses for the desired dose. In actual use conditions, the photo-optic encoder disc **132** has 72 slots although other sized discs with other numbers of slots, could be calibrated for use. Since the sensor **138** responds positively in individual slots, it is possible to set the dosage to within 0.0138 milliliter (ml) accuracy. The pump stops abruptly upon the delivery of each dose, then automatically reverses to the number of pre-set pulses in order to stop drip. Usually 10 pulses are sufficient to clear the needle **56** of any drip. This sensor **138** is wired into a circuit board **140** for dosage selection control, one of the functions of control unit **110** of **Figs. 1, 6, 8 & 9** which allows selection and control of the distance the fluid travels in pump **100**. To change the dose, manipulate a switch of dosage selection control and select the dose from a selectable dosage LCD display **112** by pressing "Function" keypad **108** until "dose" appears. Then, using the "up" and "down" arrow key pads **106**, enter the selected dosage. This number will be flashing on the LCD. To set the dose, touch the "function" keypad **108** at which time the number will stop flashing.

1 Other features of the control unit 110 "function" keypad 108 are: automatic reverse setting, a re-
2 settable counter and a dye selection, shown in detail at Fig. 1,6,8 & 9. Counter records a
3 dispensed dosage every time the hand-held injection device 40 is activated. Counter keeps a
4 running total of the number of injections given while the veterinary medicament delivery system
5 20 is turned on. The counter is reset manually by pressing the down arrow 106 on control unit
6 110. The total is recorded by a liquid crystal display 112 on the control unit 110. A micro switch
7 liquid crystal display unit, made by Curtis Instruments, Inc., 204 Kisco Ave., Mt. Kisco, NY
8 10549, has been used and works well although other LCD's could be used.

9 Up and down arrows 106 are used to select from a range of dose settings LCD display
10 112, the appropriate dose, the chosen dosage setting illuminated by a light. Dosage settings are
11 calibrated into the electronic control unit 110 to accommodate the desired dose. Also shown
12 are three switches : power on/off 114, pump 116 forward/reverse, and head lamp on/off switch
13 120.

14 Veterinary medicament delivery system 20 may be cleaned by flushing with hot, e.g.
15 160°F, detergent/water mixture placed in medicament container 80. To accomplish cleaning, the
16 pump switch on the face of the control unit is set to "forward" in order to circulate
17 cleaning/sanitizing solutions for effective "clean in place". Cleaning practices vary among
18 operators. Flushing with hot detergent water, followed by a clean rinse, is accepted by many who
19 fear harming the vaccines with disinfectants. Others flush with hot detergent water and follow
20 with an alcohol rinse, which, of course, is then rinsed.

21 All the hand-held injection devices 40, 40', 40'', 40''' & 40'''' have two signal lights on a
22 top surface thereof, namely red LED 50 signaling low medicament, and green LED 48 indicating
23 injection in progress. On the proximal surface 22 of each hand-held injection device 40, 40', 40'',
24 40''' or 40'''' dye applicator pad 172 can be mounted which, when powered on, marks each
25 animal or bird to which medicament is administered.

26 In the operation of hand-held injection device 40''', Fig. 5, trigger 42 must be depressed,
27 and the needle 56 must be fully inserted into animal or fowl, which pushes safety interlock 152
28 the tip of the needle hub 58 to complete the electrical circuit to actuate the pump 100 which
29 accomplishes administration of medicament. This double requirement of trigger 42 being

depressed and safety interlock solid member 152 pushed to a second position before the medicament is administered reduces the dangers of self-injection. And because the trigger 42 is being depressed, either serially or continually, rather than manually pushing a syringe handle in order to pump the medicament into the animal through the needle and against the pressure of a return spring, this system greatly reduces fatigue and the incidence of repetitive motion injury in the operator. Additionally, use of this system 20 permits greater speed of administration of medicament to the multiplicity of animals or fowl sought to be medicated. Hand-held injection device 40''' also having safety interlock 152, Fig. 13, works similarly to hand-held device 40'''.

In the operation of hand-held injection device 40, 40', & 40'', trigger 42 must again be depressed for each injection. Emergency stop button 44 enables the user to stop the injection in the case of either piercing the user's skin with the needle 56 or running the needle through the subject animal body, ex. the ear. This deters accidental self-injection and accidental waste of expensive medicament in the case of running the needle through the subject animal body.

Use of the electronic dosage control 130, permits changing of the dosage to be administered and is especially useful when different dosages are to be administered in succession, however, it would be equally useful in situation where a multiplicity of animals or fowl were administered the same dosage of medicament.

When it is desired that two medicaments are to be administered simultaneously, a mixing tube 190, Fig. 11 may be added between the pump 100, 100' and the hand-held injection device 40. In addition to mixing tube 190, an additional pump 100' and related tubing and T-coupling 198 are used to permit mixing of the two medicaments prior to administration.

Veterinary medicament delivery system 20 may be cleaned by flushing with hot, e.g. 160°F, detergent/water mixture placed in medicament container 80. Cleaning practices vary among operators. Flushing with hot detergent water, followed by a clean rinse, is accepted by many who fear harming the vaccines with disinfectants. Others flush with hot detergent water and follow with an alcohol rinse, which, of course, is then rinsed.

These important features allow for very precise dose from a self-priming, electrically powered pump through a valve-free system which can prevent drip, include important safety features to deter self-injection, automatically mark each animal, total the numbers of injections,

1 retrieve unused medicament and provide for an easy method of internally 'cleaning-in-place' of
2 the system.

3 Although the present invention has been described in considerable detail with reference to
4 certain preferred versions thereof, other versions are possible. Therefore, the spirit and scope of
5 the appended claims should not be limited to the description of the preferred versions contained
6 herein.